Path 15 Upgrade Analysis

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Outline

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3. Cost Study Methodology
4. Fundamental Concepts
5. Summary

Background

- **Reliability Concerns**
  - Operational difficulty on a day-to-day basis
    - all year (day and night hours)
    - winter and summer peak
    - N-1 to N-2 Contingencies
  - IRAS Project
  - Function of DCPP availability (fast ramp)
  - Significant derates with equipment out-of-service
  - Operating Reserves
  - Operating Transfer Capacity (OTC) Overloads and Violations
  - WSCC RMS OTC Sanctions ($)

Background (cont.)

- **Resource Inadequacy in NP15**
  - Increased Load Growth
  - Limited Development of New Generation
  - Reliance on Imports is Increasing ,but while Imports from Northwest are Decreasing
  - Real-Time Emergencies (Stage 1, Stage 2, and Stage 3) are declared often
  - Load Curtailments are Necessary
    - Non-Firm Load is shed and availability is depleted
    - Firm load has been shed in Northern California due to Path 15
    - Generation is available in SP15 to serve load, but Path 15 is limited
    - Not a system Operating Reserve problem

Path 15 Reliability Concerns

- 228 Overloads
  - South-to-North Direction Only
  - 1/1/98 - 1/15/01
- 51 (22%) of the overloads > 10-minute stability limit (as defined by WSCC)
- WSCC RMS Sanctions occur when overloads exceed stability limit

Path 15 Reliability Concerns
WSCC RMS OTC Violations

Year	Violations	Total Duration
1998	11	~285 Minutes
1999	5	~79 Minutes
2000	29	~450 Minutes
2001 (15 days only)	6	~73 Minutes

Path 15 Reliability Costs
WSCC RMS OTC Sanctions

Year	Total Cost
1998 (4th quarter only)	$23,400
1999	$15,600
2000	$81,900
2001 (1st quarter only)	$11,700
Total	$132,600

Real-time Emergencies

4/1/98 - 1/18/01

Declaration	1998	1999	2000	2001	Total
No Touch	8	12	72	9	101
Alert	7	2	34	-	43
Warning	8	6	80	9	103
Power Watch	NA	NA	20	-	21
Stage 1 Emergency	7	4	55	9	75
Stage 2 Emergency	5	1	36	9	51
Stage 3 Emergency	0	0	1	5	6

Real-time Emergencies (cont.)

- 2000 - Stage 3 - Bay Area - Shed firm load
- 2001 - Stage 2s - System Reserves and Path 15 - Shed non-firm load many times
  - Utilized all hours of non-firm for PG&E
- 2001 - Stage 3s - Path 15 - Shed firm load in NP15 twice

Impact of Firm Load Curtailment

Date	MW	Duration	Estimated Cost
1/17/01	500	2 hours	$18 - $44 Million
1/18/01	1000	1 hour	$18 - $44 Million
1/18/01	500	1 hour	$9 - $22 Million
Total			$45 - $110 Million*

*Based on average price of $18,000/MWh to a high price of $44,000/MWh for value of service

Background

- Path 15
  - Costs
    - Economic analysis of cost to PX loads
    - Significant congestion in forward markets
    - Significant congestion in real-time (Splitting BEEP)

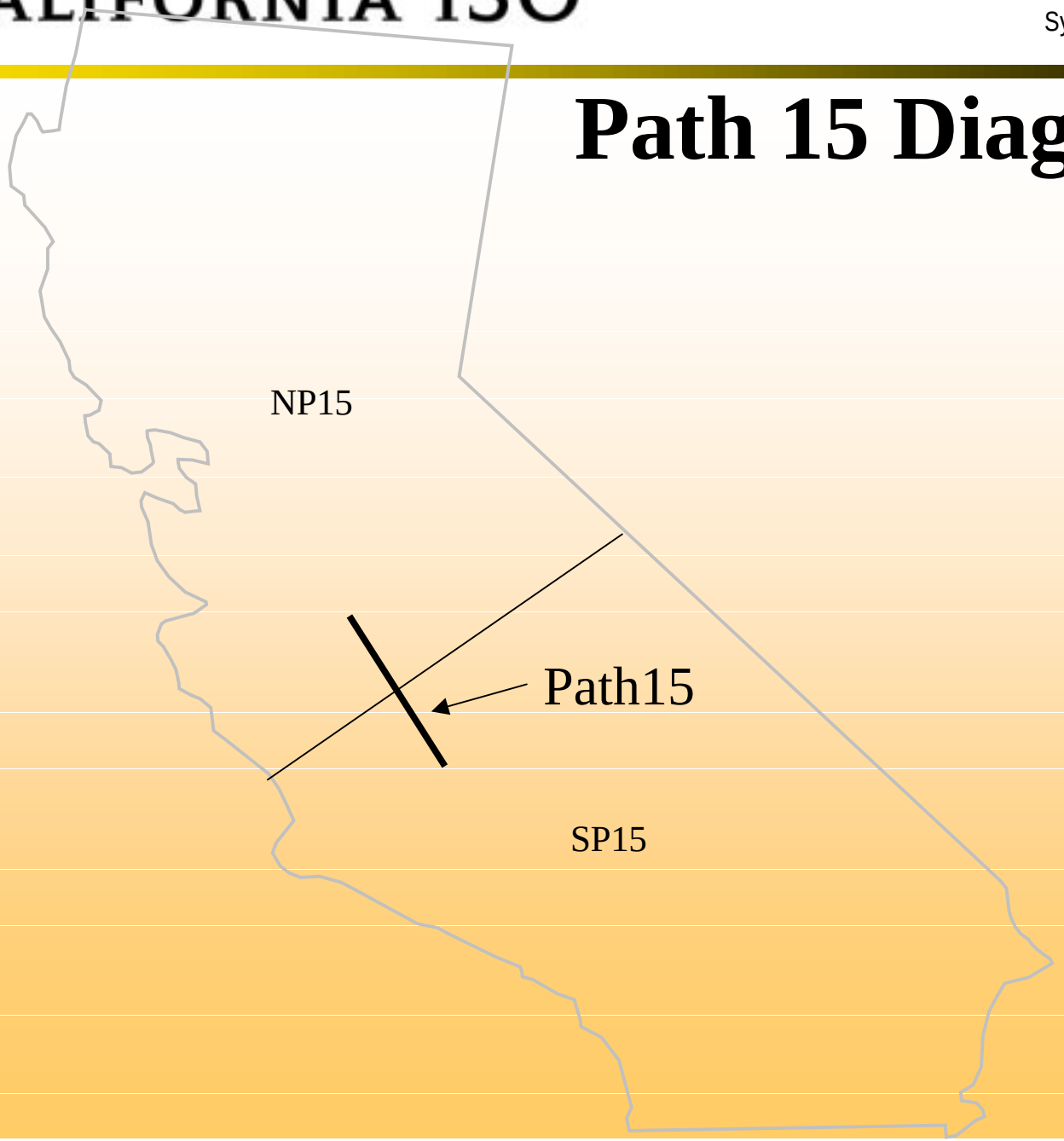
Study Methodology

- Assumption - Unconstrained prices used if there was no congestion on Path 15
- Determine Potential Cost Impacts of Upgrading Path 15
- Analyze Congestion Costs on PX Load Resources
  - Day-Ahead, Hour-Ahead, and in Real Time Markets
  - Out-of-Market (OOM)
  - Ancillary Service (A/S) Market
- Use Actual Costs For the Following Time Periods
  - 9/1/99 to 8/31/00
  - 9/1/00 to 12/31/00
- Compare Aggregated Zonal Costs Incurred due to Path 15 Congestion with Estimated Costs if Path 15 had Sufficient Capacity

Fundamental Concepts

- Congestion Management
  - Forward Market (Day-Ahead, Hour-Ahead)
    - DA/HA UMCP - Advised preferred schedules
  - Real-time Market (Imbalance Energy)
    - Splitting BEEP
    - Out-of-Market (OOM)
  - Ancillary Services (Regulation Up, Regulation Down, Spin, Non-spin, Replacement Reserve)

Path 15 Diagram



Fundamental Concepts

Options with Path 15 Congestion in the Forward Market

	NP15	SP15
LOAD	Decrease ↓	Increase ↑
GENERATION	Increase ↑	Decrease ↓

CONG will INC/DEC adjustment bids prior to making pro-rata curtailments.

Scheduling Opportunity

Between the Forward and Real Time Markets

(Example - 22,000 MW of actual load in Real Time)

	Forward		+ Real Time		= Total
Option	Load (MW)	Bid	Load (MW)	Bid	
A	20,000	$50	2,000	$125	$1,250,000
B	18,000	$10	4,000	$150	$780,000
Difference (net savings with option B)					$470,000

Equations

- Cost of congestion

  $= (C_{DA}+C_{HA}+C_{RT}) - (C^0_{DA}+C^0_{HA}+C^0_{RT})$

  $=(C_{DA} - C^0_{DA}) + (C_{HA} - C^0_{HA}) + (C_{RT} - C^0_{RT})$

- C_{XA} = Zonal Cost due to Path 15 congestion

- C^0_{XA} = Zonal Cost without Path 15 congestion after upgrades

Estimating the Unconstrained Real Time Price

- First Method (using constrained prices - one each in SP15 and NP15) has three variations:
  - Average zonal prices for each hour
  - 25% from the lower real-time zonal price
  - The lower of the two real-time zonal prices
- Second Method
  - Average the unconstrained real-time prices for similar hours over each month

Results

- Impact of Path 15 Upgrade
  - DA/HA - Compared UMCP and CMCP
  - Real-time - Estimated three prices
  - Significant savings in Forward Market (for SP15)
  - Significant costs in Real-time (for NP15)
  - Overall savings for California (OOM and A/S costs are significant from 9/1/00 - 12/31/00)
- Load Adjustment Bids used in NP15 and SP15

Results for 9/1/99 - 8/31/00

Energy/AS Market	# of Congestion Hours
Day-Ahead	3,096 / 1720
Hour-Ahead	1,392 / 262
Real-Time	1,318
(NP15 price >SP15 Price)	
Total (union)	3,392 / 1761

Results for 9/1/00 - 12/31/00

Energy/AS Market	# of Congestion Hours
Day-Ahead	1,993 / 330
Hour-Ahead	1,689 / 58
Real-Time	1,469
(NP15 price >SP15 Price)	
Total (union)	2,360 / 337

(Note: Hours for time period is 2,928)

Summary of Costs by Market

	Net Cost (Millions)	
Type of Cost	**9/1/99 - 8/31/00**	**9/1/00 - 12/31/00**
Energy (DA, HA and RT)	-$9.1	$134.0
OOM Energy	$0.6	$12.5
Ancillary Services	$61.0	$22.7
Total	$52.5	$169.2
Firm Load Totals (for 2001 ytd)		$45 - $110

Congestion Management Reform

- Final HA scheduled load within 5% of Real-time load
- Penalties for deviations
- Reduction in savings in Forward Market for SP15
- NP15
  - Increase in costs in Forward Market since load could not be decremented substantially and a more expensive resource would set the price
  - Decrease in costs in Real-time Market since real-time deviation would be smaller
- Other resources (not load) will be the marginal unit setting the MCP

Summary

- Upgrade of Path 15 will:
  - reduce the number of emergencies and curtailments of both non-firm and firm load
  - Reduce OTC violations and exposure to system wide disturbance
  - Save congestion costs for the state of California